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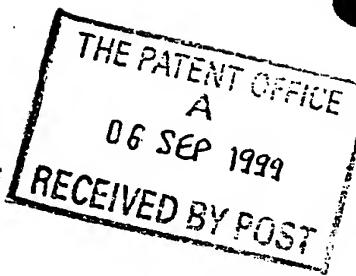
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469 P99 E74364-1 002776
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1. Your reference

IPD/P2755

2. Patent application number

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9920885.2

- 6 SEP 1999

3. Full name, address and postcode of the or of each applicant (*underline all surnames*)THE SECRETARY OF STATE FOR DEFENCE
Defence Evaluation and Research Agency
Ively Road, Farnborough
Hampshire GU14 0LX, UKPatents ADP number (*if you know it*)

54510003

If the applicant is a corporate body, give the country/state of its incorporation

GB

4. Title of the invention

Pressure Indicator and Apparatus comprising the same

5. Name of your agent (*if you have one*)Bowdery Anthony Oliver"Address for service" in the United Kingdom to which all correspondence should be sent (*including the postcode*)Defence Evaluation & Research Agency
IPD (DERA) Formalities
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6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (*if you know it*) the or each application number

Country

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(*if you know it*)Date of filing
(day / month / year)

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Number or earlier application

Date of filing
(day / month / year)8. Is a statement of inventorship and of right if to grant of a patent required in support of this request? (*Answer 'Yes' if:*

- a) any applicant named in part 3 is not an inventor, or
- b) there is an inventor who is not named as an applicant, or
- c) any named applicant is a corporate body.
See note (d)

PRESSURE INDICATOR AND APPARATUS COMPRISING THE SAME

This invention relates to a pressure indicator and apparatus comprising the same.

According to a first aspect of the present invention, a pressure indicator comprises a display diaphragm and an indicator diaphragm coupled to and in fluid communication with the display diaphragm; wherein, in use, a change in pressure applied to the diaphragms causes relative movement between the diaphragms which is observable either on the outer surface of the display diaphragm or through the display diaphragm. To see through the display diaphragm effectively, it is preferably transparent.

10 In a preferred embodiment, the diaphragms form a compartment and contain a liquid or gel which may be at least partially opaque.

In another preferred embodiment, the indicator diaphragm bears a recognisable configuration or pattern such that the configuration or pattern is observable either on the outer surface of the display diaphragm or through the display diaphragm thereby aiding observation of the relative movement. The recognisable configuration or pattern may comprise a symbol or graphic projecting from the surface of the indicator diaphragm. This facilitates observation on the outer surface of the display diaphragm if the symbol or graphic either abuts the inner surface of the display diaphragm or protrudes through the display diaphragm.

20 Alternatively, either the display diaphragm or, if present, the liquid or gel may be partially opaque. Upon relative movement between the diaphragms, the symbol or graphic which projects from the surface of the indicator diaphragm either appears or disappears or, alternatively, becomes more or less visible when viewed through the display diaphragm.

25 In order to indicate a range of pressure, it is necessary to define the two extremes of that range, i.e. a high pressure extreme and a low pressure extreme. Thus, it is preferable that the configuration or pattern comprises at least two components, each component corresponding to a different pressure.

Such components may project from the surface of the indicator diaphragm by different amounts, thereby abutting the display diaphragm at different pressures. Alternatively, the components may have different visibility such that they can become

visible and invisible at different pressures, e.g. by having different colours or symbols and patterns.

The relative movement of the diaphragms may be accommodated where either diaphragm comprises a flexible polymer and especially an elastomer. The symbol or

5 graphic may also comprise a flexible polymer or elastomer.

Where the indicator diaphragm is subjected to a higher pressure than the display diaphragm, it is preferable that the indicator diaphragm is impermeable so as to prevent leakage.

According to a second aspect of the present invention, apparatus comprises a fluid

10 reservoir and a pressure indicator according to any preceding claim wherein one of the diaphragms is in fluid communication with the fluid reservoir. The apparatus may be an inflatable such as a tyre or a ball.

The pressure indicator may be incorporated in the surface of the fluid reservoir or, more conveniently housed in or around a valve assembly.

15 According to a third aspect of the present invention, a method of indicating either fluidic or mechanical pressure comprises the steps of applying a pressure to a pressure indicator, the indicator comprising a display diaphragm and an indicator diaphragm coupled to and in fluid communication with the display diaphragm; and observing the relative movement between the diaphragms caused by the pressure

20 applied, either on the outer surface of the display diaphragm or through the display diaphragm.

Preferably, the indicator diaphragm bears a recognisable configuration or pattern such that the relative movement is observed either when the pattern or configuration abuts the display diaphragm, or when the pattern or configuration becomes visible

25 through the display diaphragm.

In a preferred method, the pattern or configuration may comprise a symbol or graphic having at least two components where each component corresponding to a different pressure. This enables a pressure range to be defined whereby one of the components defines a lower relative pressure, the other a higher relative pressure.

The invention will now be described, by way of example only, with reference to the figures in which:

Figure 1 shows, schematically, a football having a pressure indicator according to the present invention;

5 Figure 2a shows a cross-section of the pressure indicator of figure 1 when the football is under inflated;

Figure 2b shows the indication visible on the pressure indicator of figure 1 when the football is under inflated;

10 Figure 2c shows a cross-section of the pressure indicator of figure 1 when the football is correctly inflated;

Figure 2d shows the indication visible on the pressure indicator of figure 1 when the football is correctly inflated;

15 Figure 2e shows a cross-section of the pressure indicator of figure 1 when the football is over inflated;

Figure 2f shows the indication visible on the pressure indicator of figure 1 when the football is over inflated; and

Figures 3a and 3b show, schematically, a valve having a pressure indicator according to the present invention.

Figure 1 shows, schematically, a football 1 having a pressure indicator 2 according
20 to the present invention. A valve 3 is positioned in the wall of the football, whereby,
using conventional methods, the football can be inflated through the valve, e.g. by
using a pump (not shown). The pressure indicator is exposed to both the internal
pressure of the football and atmospheric pressure outside the football. It will be
appreciated that there is an optimal range in which a football should be pressurised
25 for bounce and control. Below this range, the football can be said to be under inflated
and above, it can be said to be over inflated.

Figure 2a shows a cross-section of the pressure indicator 2 when the football 1 is
under inflated. The pressure indicator comprises a transparent display diaphragm 4
coupled to and in fluid communication with an indicator diaphragm 5. The
30 diaphragms form a compartment 6. The surface of the indicator diaphragm has
projecting therefrom a diamond symbol 7 and a cross symbol 8 where the diamond
symbol projects further from the indicator diaphragm than the cross symbol. An

opaque gel fills the remainder of the compartment. An example of a suitable gel is a silicone rubber although a person skilled in the art will be aware of other suitable materials.

Figure 2b (not to scale) shows the indication visible through the display diaphragm 4
5 of the pressure indicator 2 when the football 1 is under inflated. When under inflated,
neither the diamond 7 or the cross 8 are visible through the display diaphragm 4 due
to the opaqueness of the gel contained in the compartment i.e. they do not contact
the indicator diaphragm.

Figure 2c shows a cross-section of the pressure indicator 2 when the football 1 is
10 correctly inflated. Pressure is exerted on the indicator diaphragm 5 which is sufficient
to cause the indicator diaphragm to depress, thereby allowing the diamond 7 (but not
the cross 8) to abut the display diaphragm 4. When the diamond abuts the display
diaphragm, the opaque gel is displaced such that the diamond becomes visible when
viewed through the display diaphragm as shown in figure 2d (not to scale).

15 Figure 2e shows a cross-section of the pressure indicator of figure 1 when the
football 1 is over inflated. The pressure exerted on the indicator diaphragm is greater
than that as shown in figure 2c resulting in greater relative movement between the
diaphragms. As such, both the diamond and the cross abut the display diaphragm
and thus become visible when viewed through the display diaphragm as shown in
20 figure 2f (not to scale).

Figure 3a shows, schematically, a valve 9 having a pressure indicator 10 according
to the present invention. In use, the valve is connected to an inflatable or inflated
object 11. The indicator assembly 12 is positioned within the transparent valve
casing 13 so as to be visible when viewed from above. The pressure indicator is
25 exposed to atmospheric pressure and also the internal pressure of the object via the
pressure equalisation channel 14.

Figure 3b shows, schematically, a valve 15 having a pressure indicator 16 according
to the present invention. In use, the valve is connected to an inflatable or inflated
object 17. The indicator assembly 18 is positioned within the transparent valve
30 casing 19 which acts as a guide to light entering the casing so the indication is
visible when viewed from above. The pressure indicator is exposed to both the
internal pressure of the object and atmospheric pressure.

CLAIMS

1. A pressure indicator comprising
a display diaphragm, and
an indicator diaphragm coupled to and in fluid communication with the display diaphragm;
wherein, in use, a change in pressure applied to the diaphragms causes relative movement between the diaphragms which is observable either on the outer surface of the display diaphragm or through the display diaphragm.
2. A pressure indicator as claimed in claim 1 wherein the display diaphragm is transparent.
3. A pressure indicator as claimed in claim 1 or claim 2 wherein the diaphragms form a compartment.
4. A pressure indicator as claimed in claim 3 wherein the compartment contains a liquid or gel.
5. A pressure indicator as claimed in claim 4 wherein the liquid or gel is partially or fully opaque.
6. A pressure indicator as claimed in any preceding claim wherein the indicator diaphragm bears a recognisable configuration or pattern.
7. A pressure indicator as claimed in claim 6 wherein the recognisable configuration or pattern comprises a symbol or graphic projecting from the surface of the indicator diaphragm towards the display diaphragm.
8. A pressure indicator as claimed in claim 6 or claim 7 wherein the configuration or pattern comprises at least two components, each component contacting the display diaphragm at different pressures.
9. A pressure indicator as claimed in claim 8 wherein the at least two components have different colours.

10. A pressure indicator as claimed in claim 8 or claim 9 wherein the at least two components have different visibility.
11. A pressure indicator as claimed in any preceding claim wherein either the display diaphragm or the indicator diaphragm comprises a flexible polymer.
12. An article comprising a fluid reservoir and a pressure indicator according to any preceding claim wherein one of the diaphragms is in fluid communication with the fluid reservoir.
13. An apparatus according to claim 14 wherein the apparatus is an inflatable.
14. A method of indicating fluidic or mechanical pressure using a pressure indicator according to any of the preceding claims.
15. A ball comprising a pressure indicator as claimed in any preceding claim.

ABSTRACT

A pressure indicator and a corresponding method are disclosed, the pressure indicator comprising a display diaphragm, optionally transparent, and an indicator diaphragm coupled to and in fluid communication with the display diaphragm. In use, pressure is applied to the diaphragms whereby a change in the pressure applied causes relative movement between the diaphragms which is observable either on the outer surface of the display diaphragm or through the display diaphragm. The diaphragms may form a compartment preferably containing a liquid or gel. The indicator diaphragm may bear a recognisable configuration or pattern which can be coloured and may comprise a symbol or graphic projecting from its surface. The configuration or pattern may comprise at least two components, each component corresponding to a different pressure. Also disclosed is an inflatable device, especially a football or a tyre, comprising such a pressure indicator.

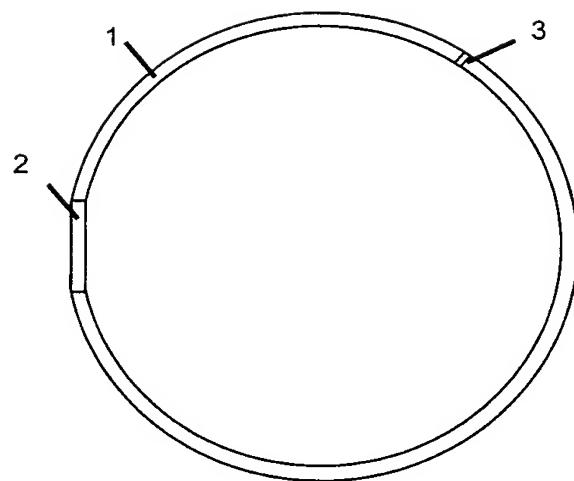


FIG. 1

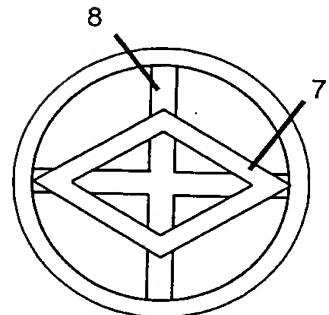
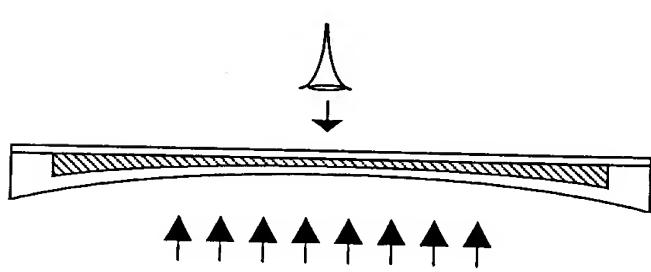
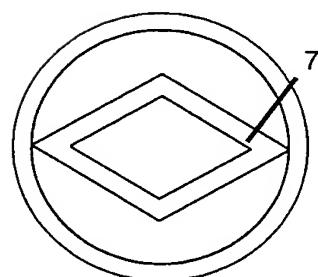
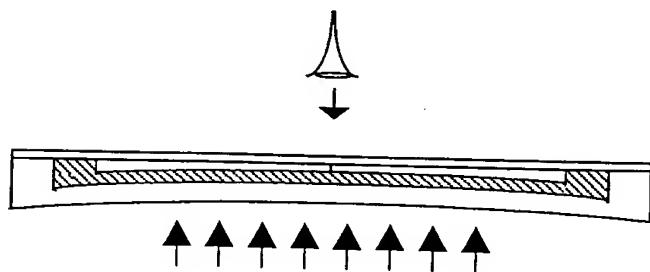
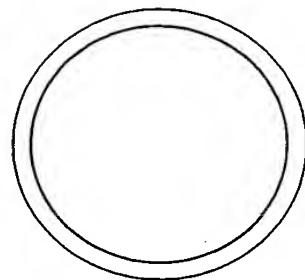
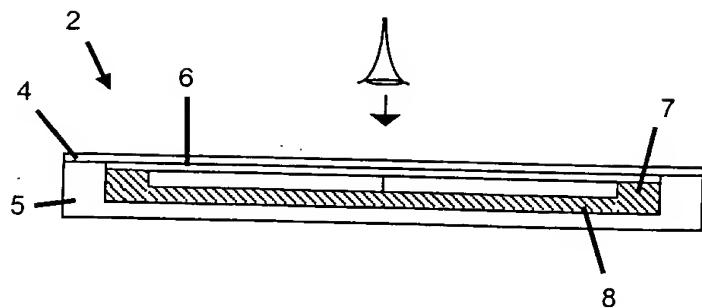


FIG. 3